WATER RESOURCES RESEARCH GRANT PROPOSAL

Project ID: 2002TN3B

Title: Acid Catalyzed Hydrolysis of Wastewater Activated Sludge for Removal and Possible Conversion to Products

Project Type: Research

Focus Categories: Treatment, Waste Water, Models

Keywords: activated sludge, data analysis, economics, energy use and conservation, mathematical models, optimization, pollution control, waste disposal

Start Date: 03/01/2002

End Date: 02/29/2004

Federal Funds: $25,000

Non-Federal Matching Funds: $64,799

Congressional District: TN2

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Abstract

Both municipal and industrial treatment of wastewater using an activated sludge process generates large quantities of biosolids referred to as sludge. Currently the Knoxville Utility Board (KUB) generates 65 tons/day of these solids (dry basis) from their activated sludge wastewater treatment facilities. This material is concentrated from 4.2 wt % up to 35 ? 40 wt % via filtration and disposed off-site by trucking it over 70 miles for disposal through land farming. Every year the distance becomes greater due to KUB?s inability to find acceptable sites for land farming. At least several industries (DuPont and Tennessee Eastman) have similar problems with sludge disposal. On site destruction of the excess biosolids is preferred from both an economic and environmental standpoint. Currently both Dupont and Tennessee Eastman use on site incineration and would prefer a more environmentally benign process which uses less energy. A nitric acid catalyzed hydrolysis process can convert most of the sludge into a biodegradable material suitable for recycle. There is also a possibility that the sludge could be converted into acetic acid for commercial sale. The major products from this hydrolysis are organic acids. It may be possible to optimize production of these acids to the point were it is economically feasible to convert the waste activated sludge stream into a commercial product. If it is not economically feasible to recover the organic acids the stream can be recycled back to the waste treatment unit where the organic acids will biodegrade.

This proposal will consist of a batch scale kinetic study using activated sludge from KUB?s Kuwahee treatment facility, employing a factorial experimental design. The variables consist of residence time, reaction temperature, solids concentration, and nitric acid concentration; with percent conversion and acetic acid concentration as the dependent variables. The concentration of the sludge can have a significant impact on the economics of any potential process and must be investigated. The sludge stream from KUB?s

activated sludge treatment process is 4.2 wt % and is concentrated to 35 ? 40 % by filtration prior to land farming. A feed sludge concentration in the range of 4.2 - 40 wt % will be investigated. The data will be analyzed and a mathematical model will be developed for the reaction kinetics over the range of the input variables. The form of the model will depend on the experimental data. If significant quantities of organic acids are obtained a complex model will likely be required; if the organic compounds are not produced in sufficient quantity a much simpler model describing destruction kinetics will be employed. The model will be utilized to evaluate the economics of the process and to develop a preliminary process design. A continuous pilot scale unit will be designed and built. This unit will be used at KUB?s Kuwahee treatment facility in the second year of the project.